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†† *Spur 2 cm. or shorter.*

§ *Glandular-pubescent.*

11. **A. micrantha** Eastw. Proc. Calif. Acad. Sc. Ser. II, 4:559, t. 19. Gray, Syn. Fl. 1:43. Rydb. l. c. 136.

A slender species, 3 dm. or taller; leaves on short petioles; flowers 2 cm. or somewhat longer; sepals ovate-oblong, acute, 1 cm. long; petals truncate or nearly so, spur slender: follicles 1 cm. or somewhat longer, viscid-pubescent.

In cañons, S. E. Utah and southward.

§§ *Glabrous or nearly so.*

12. **A. flavescens** Wats. Bot. King's Exp. 10, 1871. Gray, Syn. Fl. 1:43.

A. canadensis var. *aurea* Regel, Gartenfl. 21:t, 734.

5 dm. or higher, branching; leaves on long petioles; sepals ovate-oblong, spreading, 1.5-2 cm. long; the broad laminae of the petals one-half as long as the somewhat curved spur; follicles 2 cm. in length, pubescent.

Aspen and Spruce Regions, Wasatch Mountains, Utah.

A. flavescens f. minor, Subalpine, smaller and more hairy. Wasatch Plateau. (Tm.)

††† *Spur 4 cm. or longer.*

13. **A. chrycantha** Gray, Proc. Am. Acad. 8:621, 1873; Syn. Fl. 1:44, Masters, Gard. Chron. 1873, f. 304, Rydb. l. c. 137.

A. leptocera var. *chrysantha* Hook. f. Bot. Mag. t. 6073, 1873.

5 dm. or taller, glabrous below; sepals lanceolate-oblong, 2 cm. or longer; the slender spur about four times as long as the broad laminae of the petals; follicles 2 cm. or longer.

Southern Colorado and southward.

Bureau of Plant Industry,
Department of Agriculture,
Washington, D. C.

An Analytic Study of Faunal Changes in Indiana.

WALTER L. HAHN.

REPTILES AND AMPHIBIANS.

We have less direct evidence regarding present and former numbers of these classes than any other conspicuous group in our fauna. Several local histories mention snakes and especially, the abundance of rattlesnakes. There is no direct evidence as to comparative abundance of the smaller snakes, turtles, frogs and salamanders of the past and present. Their ecological position gives us some idea as to whether they are increasing or diminishing.

Snakes are universally disliked and most people will kill them whenever possible. Three venomous species were not uncommon in the State. The copperhead was abundant in the southern half, the prairie rattlesnake in the northern half and the banded rattlesnake was not uncommon in all parts. At the present time the latter species is practically extinct, the copperhead is rarely found except in rugged, uncultivated localities and the prairie rattler is limited to the vicinity of swamps and marshes.

These species have been systematically hunted down by man in defense of himself and his property. Other species that are reported venomous, as the black snake or blue racer, and the hog nosed snake or spreading viper have shared their fate.

The garter snakes and water snakes are much more prolific, and being rather timid and living chiefly in rank vegetation, not near houses, they have maintained their place in the fauna much better. All species have suffered destruction by hogs and it is doubtful whether any of the more common serpents are as numerous now as a century ago.

Turtles also have diminished in abundance. Hogs eat them as well as snakes (Culbertson, '07), and probably exerted a very great influence upon the reptilian and amphibian fauna in the days when they were permitted the freedom of the woods. Ponds and marshes have been drained, creeks have dried as the result of deforestation, and lake shores which were formerly used as breeding grounds by turtles are now occupied by human habitations. All of these things have tended to diminish their number.

Amphibians have been acted upon by the same influences as turtles. There is this difference, however, turtles were practically immune from attack by wild creatures of the forest. Frogs and salamanders were eaten by snakes, waterfowl, opossums, raccoons and other carnivorous animals. Most of these species have been greatly reduced and hence the frogs have lost many enemies. Man is not usually an active enemy of these creatures, hence his influence upon them is principally indirect and consists in draining swamps and reducing land to cultivation. As there are pools of water left in every community, the animals are not entirely dispossessed of breeding places. On the whole, it does not seem probable that the amphibians have greatly diminished in number as a result of the settling of the State.

FISHES.

Fishes, both large and small, were abundant in the waters of Indiana during the early days of settlement. The shovel-nosed sturgeon, paddle fish, buffalo, alligator-gar and many others grew to considerable size and contended for supremacy in the rivers and streams of the southern part of the State, while muskallunge, whitefish, lake sturgeon, cisco and others were abundant in the northern lakes. The pioneers speared, gigged, trapped and seined them without let or hindrance. Naturally, the best time to capture many of them was while they were ascending the smaller streams to spawn. By the light of torches or blazing bonfires along the bank many pounds of fish could be speared or gigged in a single night. But they were often taken before spawning and the next generation was lost. The only possible result was the diminution of many of the larger species.

Large fish live for the most part upon the smaller ones. How have these fared? Have they been given added opportunities as some of the smaller birds and mammals have?

The problem is not by any means the same, for the fish fauna is closely dependent upon the character of the streams as well as food and protection. In the northern part of the State there were many lakes, some of them quite deep, some mere marshes, but all with more or less of shallow, reedy margins. The outlets were generally sluggish and consequently more or less choked by aquatic plants. The shallow parts of the lakes are easily drained and make exceedingly fertile land. In many places lake levels have been lowered several feet by cutting ditches and straightening the channels of the outlets. At other points, entire lakes or marshes have been drained in the same way; the most notable instances being Beaver Lake and English Lake. The water area in this region has therefore been considerably lessened and drainage has often progressed rapidly enough to destroy large colonies of aquatic plants and animals, thereby lessening the food supply for the fishes and occasionally killing fishes themselves.

In the southern part of the State there were few lakes and marshes but many streams. Deforestation has had a tremendous influence upon the character of the streams. The one that has been longest familiar to the writer is Willow

Creek, in Ohio County. This is a small stream with a bed in shale and soft limestone. Twenty years ago the hills bordering it were almost all covered by forests. The creek had many pools two or three feet deep and from one to several rods long. The stream flowed most of the year and even during droughts the pools contained much water, pure enough to afford homes for fishes. The stream was too small to support large species, but bullheads, sunfishes and several species of minnows and suckers were abundant and were frequently caught on hook and line.

At the present time the forests are cleared and all the hills bordering the stream are under cultivation unless too rocky and barren to produce a crop. The stream has lowered its bed noticeably (probably two feet on the average in 20 years) and the character of the stream is greatly changed. Now it flows only during the wet months of the year, ceasing soon after the flow of surface water is exhausted, but becoming a raging, unfordable torrent after heavy rains. The floods have changed the character of the stream, bed so that large pools no longer occur in times of drought only a few small, stagnant pools, fed by seepage from springs, can be found in the entire course of the stream. These contain no fishes large enough to take the hook, and only one or two small species of minnows inhabit them.

Willow Creek is here described because the writer has personal knowledge of the facts. It is typical of all the smaller streams that have cut their beds in the Ordovician rocks of southern Indiana and more or less typical of small streams throughout all the southern part of the State. Paradoxical as it at first seems, destruction of the forests has meant destruction of the fishes.

I know of but one direct comparison that has been made between past and present fish fauna of the same stream, and that has not been published heretofore. In 1885, and a few years previous, Eigenmann and others made extensive collections in Bean Blossom Creek, a tributary of White River, not far from Bloomington, Indiana. Altogether, 40 species were taken, 32 of them being collected in one day, September 12, 1885. In 1904 three experienced and energetic collectors, Dr. A. M. Banta, now of the Cold Spring Harbor Laboratory, of the Carnegie Institution; Dr. Newton Miller, now of Clark College, and W. L. McAtee, now of the Biological Survey, of the U. S. Department of Agriculture, collected fishes in the same stream with avowed intention of breaking the record for number of species. Collections were made on but a single day, May 24, and although their results might not compare with the list of Eigenmann, collected through a period of several years, it should be as large as that taken in a single day nineteen years earlier, unless there was a change in the fauna.

The list of Banta, McAtee and Miller includes only twenty-four species, of which twenty-one were taken by Eigenmann and three are new to the stream.

The following is Eigenmann's list of 1885 with his comments upon their abundance. The nomenclature is not corrected to date but the common names are added. The species that were taken again in 1904 are checked thus *.

1. *Ammocoetes branchialis,* Brook lamprey. Abundant in spring.
2. *Noturus gyrinus,* Tadpole Cat. Two specimens.
3. **Noturus miurus,* Brindled Stonecat. Very abundant.
4. *Noturus flavus,* Stonecat. Very common.
5. *Noturus exilis,* Slender Stonecat. One specimen.
6. *Leptops olivarius,* Yellow Cat.
7. *Ameiurus melas,* Black Bullhead.
8. **Ameiurus natalis,* Yellow Bullhead.
9. **Catostomus teres,* Common sucker. Very abundant.
10. *Catostomus nigricans,* Hogsucker. Abundant.
11. **Minytrema melanops,* Spotted sucker. Abundant.
12. **Moxostoma macrolepidotum,* Red Horse.
13. **Campostoma anomalum,* Stone-roller.
14. *Chrosomus erythrogaster,* Red-bellied Dace.
15. *Hybognathus nuchalis,* Silvery Minnow.
16. **Notropis whipplii,* Silverfin.
17. **Notropis megalops,* Common Shiner.
18. **Notropis ardens lythrurus,* Blackfin.
19. *Rhynichthys atronasus,* Blacknosed Dace.
20. *Hybopsis biguttatus,* River Chub.
21. **Hybopsis amblops,* Silver Chub.
22. *Semotilus atromaculatus,* Horned Dace.
23. *Esox vermiculatus,* Little Pickerel.
24. *Labidesthes sicculus,* Brook Silverside. One specimen.
25. *Aphredoderus sayanus,* Pirate Perch. One specimen.
26. *Pomoxys annularis,* White Crappie. Very abundant.
27. *Pomoxys sparoides,* Calico Bass.
28. **Ambloplites rupestris,* Goggle-eye.
29. **Lepomis cyanellus,* Blue Sunfish.
30. **Lepomis megalotis,* Long-eared Sunfish. Abundant.
31. **Micropterus dolomieu,* Black Bass. Abundant.
32. **Boleosoma olmstedi maculatum,* Johnny Darter. Abundant.
33. *Diplesion blennoides,* Green-sided Darter. Abundant.
34. **Percina caprodes,* Log-Perch. Abundant.
35. **Hadropterus phoxocephalus.*

36. **Hadropterus scierus.* Abundant.
37. **Hadropterus aspro.*
38. **Etheostma flabellare,* Fan-tailed Darter. Abundant.
39. **Etheostma coeruleum,* Rainbow Darter.
40. *Uranidea richardsoni,* Miller's Thumb.

In addition the 1904 collection contained *Ericymba buccata,* Silver-mouthed Minnow; *Pimephales notatus,*Blunt-nosed Minnow, and *Phenacobius mirabilis,* Sucker-mouthed Minnow. Nineteen of the forty species taken in 1884 and 1885 were not found in the same stream 20 years later.

Nine of these, or 40 per cent., are large enough to be caught on a hook and the others, or 55 per cent., are too small to be taken in that way. Of the species that have disappeared, three small and two large ones were formerly abundant in the stream, three small ones were rare and the abundance of the others is not noted. Atogether, twelve of the nineteen species are either abundant or at least of common occurrence in this region, while the other seven are not very common.

Classified on the basis of food*, eleven of the exterminated species subsisted chiefly on animal food, five are either omnivorous or feed principally on mud, and the food of three is unknown to me.

Twenty-four species were taken in 1904. Of these eight, or 33⅓ per cent., are large enough to be taken by fishermen and 16, or 66⅔ per cent. are too small to take the hook. Twenty-two, or over 90 per cent, are common fishes of the region. Two species are rather rare. One of these, *Hadropterus scierus,* was first described from this stream and has since been taken in several states of the Mississippi basin, but is not as common as many of the darter family, of which it is a member. The other is the sucker-mouthed minnow, *Phenacobius mirabilis,* not heretofore reported from Indiana, but rather common in Illinois and farther west. Apparently it is migrating eastward.

Twelve of the collection of 1904 are reported to subsist principally on food of an animal nature, while five eat a considerable amount of vegetable matter. The food of the others is not known, but the majority of them probably subsist wholly or largely on animal food. In both lists, the great majority of fishes are those that prefer clear streams and rocky or sandy bottoms, as might be expected in a comparatively swift, rocky creek.

The presence of *Phenacobius mirabilis* is interesting although it may be without special significance. If the eastward migration of this species is part of a general movement, it is of extreme interest. The certainty of an eastward movement of birds has been pointed out and also the probability of such a movement among mammals. Something similar is going on among the insects. In each of these classes it is undoubtedly the result of deforestation, but if there is a similar movement of the fishes, it is far more difficult to explain.

A comparison of percentage given above for the two periods seems to indicate that small species have a slight advantage, and that species numerous in the region are more apt to survive than those that are rare, without regard to their abundance in any particular stream. No tendency with regard to food is evident. It is of interest to note that but two of the seven cat fishes occurring at the earlier period were found at the later date, while only one of the eight darters had disappeared.

The data are insufficient to warrant any sweeping conclusions but a reduction in the number of species has taken place without question and it is, perhaps, the most significant fact to be learned from this study.

MOLLUSCA AND CRUSTACEA.

There is little information as to the former abundance of these two groups. Land snails are most abundant in the woods under decaying logs and leaves. With the exception of the slugs, they are not very common in cultivated or grassy land. It therefore seems evident that the land Mollusca are less abundant at the present time than formerly, for even in the remaining forest, the underbrush and logs are usually cleared away so that there are few places for them to deposit eggs.

Certain species of crayfishes live in burrows in marshy places more or less remote from large bodies of water. In such places they erect cylindrical stacks of mud about the entrance of their burrows and these "craw-fish chimneys" are conspicuous features of many poorly drained pastures and meadows. As land has become more valuable, these swampy places have been tiled or ditched and often placed under cultivation. Consequently they have become unfit for crustacean inhabitants and the latter must have diminished.

In the ponds, lakes and streams, the same conditions that affect the fish fauna (p. 174.) have acted upon the aquatic Crustacea and Mollusca. Deforestation has brought floods that have torn up stream bottoms in the course of an hour. Silt comes down from the hillsides by the ton and makes the water of the streams so dense that animal life can scarcely exist in them. Fishes are active creatures and have some chance of escaping into the more quiet pools and eddies, but the crayfish are sluggish and are crushed by overturning rocks and buried unde debris before they can escape. Much less can the slow moving snails and mussels escape danger where the bottom on which they rest is torn up or buried inches deep under mud or stones, or where logs, plants or other objects to which snails cling are dashed against banks or whirled away by raging torrents.

Ponds and lakes are also made turbid by the silt of plowed fields and the smaller Crustacea are smothered by the muddy water. Draining destroys marshes and annihilates aquatic plants and animals by the billion. The larger lakes and rivers are doubtless affected less than the small ones, but the character of their waters also is changed and the weaker species must suffer in consequence. In recent years the pearl mussel industry has grown so rapidly that mussels have become scarce where they were once abundant and there is danger that they may be exterminated unless the industry is regulated.

In spite of the fact that we have no recorded information in regard to the former abundance of Mollusca and Crustacea, and little knowledge of their present number, there can be no doubt that both groups have diminished. With the exception of the river mussels, none of the species of either class found in the State have any direct value to man. They furnish, however, the basis of food supply for the vast majority of fishes and are also eaten by many birds. Their diminution is therefore an economic loss, although some of the conditions that have caused them to dimish may more than counterbalance the loss.

INSECTS.

Mr. Max Ellis, of Indiana University, has contributed the data and generalizations for this section of the paper, although his notes have been rewritten to form a connected account.

Probably many insects have increased, and several have been added to the fauna, by introduction or migration. Unfortunately we have little knowledge of the vast majority of species and this account is necessarily limited to a few of the larger species and a few of considerable economic importance. During the larval stage, many insects are dependent upon one or few species of plants for food, and since they have not the ability to move rapidly or far, their presence or absence in any locality may be determined by the presence or absence of a certain plant.

Butterflies are doubtless better known than any other insects and our knowledge of their range is more complete. Blatchley ('91) has published a list of the species known to occur in the State, with localities at which they had been reported. Mr. Ellis has collected in most sections of the State during the past two or three years and we therefore have a means of determining changes that have taken place during the last eighteen years.

The giant sulphur, *Callidryas ebule,* was reported only from Vanderburgh County in 1891, where a local collector, S. G. Evans,"took from one to half a dozen almost every season." Mr. Ellis took three at Vincennes in 1906, several in 1907, and several in 1908, and says that it was very common there in 1909, as many as a dozen being seen in the course of an hour. The food plants are cassia, wild senna and clover. These are not of recent introduction and the present increase of the butterfly is not due to a change in food supply but probably to a northward migration along tributaries of the Mississippi.

The black swallowtail, *Papilio polyxenes,* was said by Blatchley to be, next to the giant swallowtail, the rarest butterfly of the group. Mr. Ellis says that it is now the most abundant of the swallowtails in every part of the State, and even one of the commonest of all butterflies. The larvae feed upon the wild parsnip and other *Umbelliferae* and these are, for the most part introduced plants that have become common only in recent years.

In six years collecting Blatchley saw only two living specimens of the giant swallowtail, *Papilio cresophontes,* finding none at Bloomington, "although a constant outlook has been kept for it." Ellis says it is still our rarest *Papilio,* but it is fairly common throughout the State. He has taken it at Bloomington, Mitchell, Shoals, Vevay, Indianapolis, Anderson and Winona Lake. I have myself seen as many as fifteen in one afternoon, my zoology class having taken ten or twelve in the course of an hour between Milford and Syracuse in Kosciusko County. The food plants are the hop tree and prickly ash and these must be on the decrease, although still common in many places. The reason for the increase of the butterfly is probably a northward and eastward migration of the species. This movement was noted some years ago by Edwards.

Scudder, in 1886, reported the gray emporer, *Chlorippe celtis,* from the extreme southwestern tip of Indiana. In 1891 Blatchley reported it as far north as Wabash but said that it was scarce everywhere. Ellis found it common on the State forestry reserve at Henryville, at Anderson and at Indianapolis, abundant at Vincennes and very abundant at Vevay. The larvae feed upon the hackberry tree. The species is southern and is probably working its way northward.

The harlequin cabbage bug, *Murgantia histrionica,* is a native of Guatemala and has migrated northward through

Mexico into Texas and thence spread slowly through the southern states. (Lugger, '00.) It was south of Virginia at the time of the civil war and in 1900 had reached New Jersey and Missouri. Since 1900, probably within the past five years, it has reached Indiana. It is a serious pest, eating cabbage, turnips, and other cruciferous plants, but has not yet become numerous enough to do much harm except in the southwestern corner of the State.

The striped potato beetle, *Leptinotarsa decemlineata,* probably came from Mexico in the first place, but first migrated northward along the eastern base of the rocky mountains to Colorado. There were no suitable food plants on the plains east of that region, until they were settled and crops of potatoes were planted. This condition was fulfilled about 1850 and the beetles then began an eastward migration, reaching Indiana in 1866. Since that time it has been a serious pest.

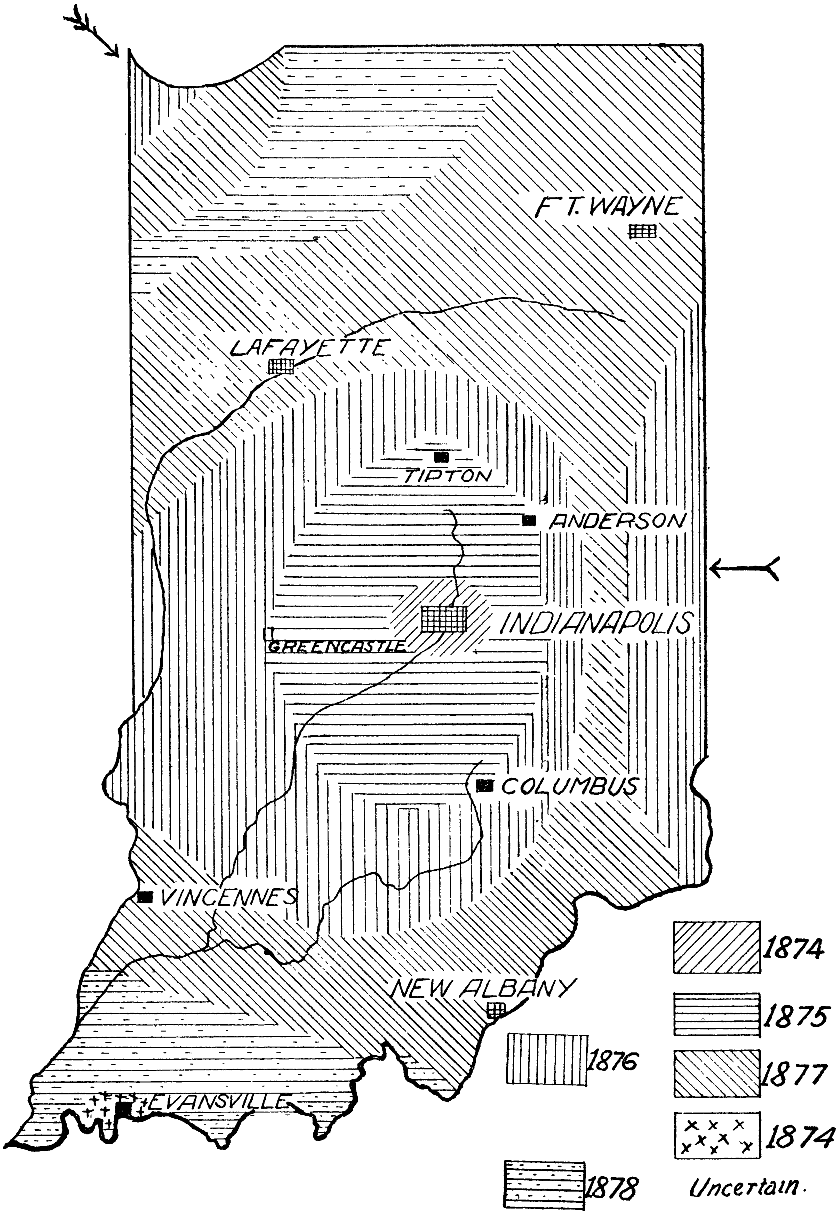
A number of insects have been introduced into the United States from Europe and have been carried to, or have migrated to Indiana.

The best known is the cabbage butterfly, *Pontia rapae.* It was introduced at Quebec in 1860 and first appeared in this State at Indianapolis in 1874. It was probably carried there by trains as the nearest point at which it was then known was Columbus, Ohio.

It spread from Indianapolis during 1874 and 1875, (see map), reaching Tipton, Anderson, Columbus and Greencastle during the latter year. In 1876 the main army, migrating through Ohio, reached Indiana and the next year the two divisions were united in the eastern part of the State. In 1876 the species also entered the northwestern part of the State from Chicago, and in 1878 this colony became joined to the main vanguard and the species had completely covered the State. The principal direction of migration of this species was westward, contrary to the usual course of the native species of the region. (Account based on Scudder, Butterflies of New England.)

The horn fly, *Hematobia serrata,* which is a pest on cattle during the summer, and the grape berry moth, *Eudemis botiana,* were also introduced from Europe, the former about 1886, the latter much earlier. The horn fly spread rapidly, reaching Indiana in about two years, and soon overspread all of the region east of the Rocky Mountains. The grape berry moth spread slowly and reached this State during the late nineties.

The San José scale was introduced into California about 1870. It was not discovered in the east until 1893, when it



Sketch map of Indiana showing the rapid dispersal of the cabbage butterfly, *Pontia rapæ.* There were three introductions, one at Indianapolis, the other two at the points and from the directions indicated by the arrows. There is also an uncertain record of a fourth introduction at Evansville.

Scale about 45 miles to the inch. Adapted from Scudder.

appeared in Virginia. It was found, however, that it had been introduced into Virginia from New Jersey in 1891. (Bull. No. 3, U. S. Bureau of Entomology, U. S. Dept. of Agriculture.) The same year it was introduced into Washington County, Indiana, on apple trees shipped from New Jersey, but it was not discovered until 1894. It has since appeared in many parts of the State, but its further spread is being checked by rigid inspection.

The imported elm leaf beetle, *Galerucella luteola,* was brought to this country in 1834, but was confined to the east until 1890, when it was carried to Kentucky. Ten years later it was introduced into Indiana at Tobacco Landing, Harrison County. It spread very slowly but was carried on trees or by wagons to Elizabeth and New Middleton, and has now spread over most of the southeastern third of that County. (See map.) It is not active in flight and hence spreads very slowly, except where it is carried. It crawls a great deal, however, and hence is sometimes carried by wagon.

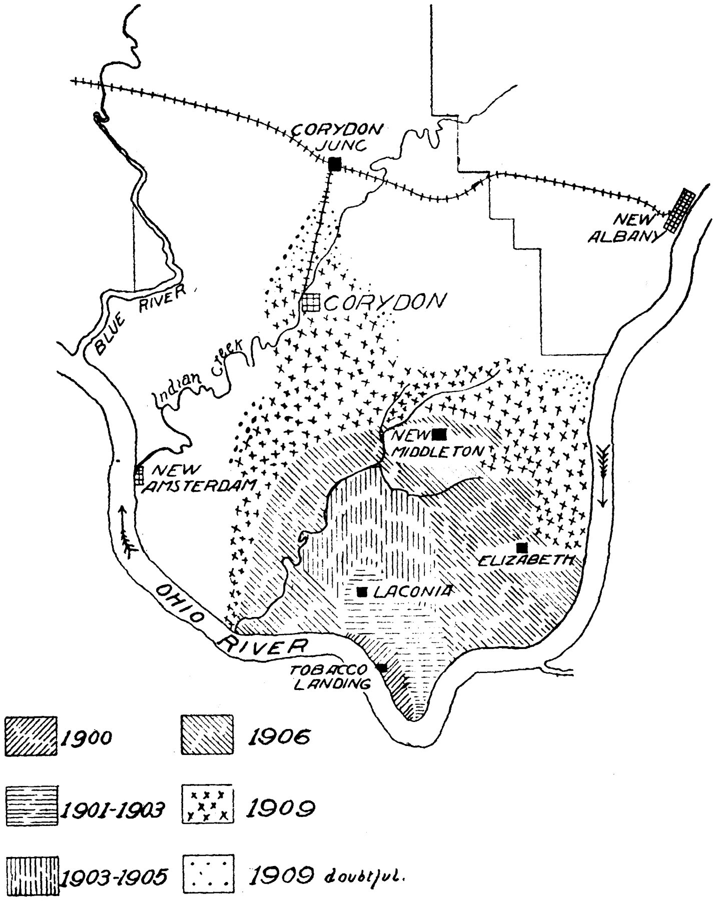
Not every species of insect has increased. No doubt wood boring beetles, and forest insects of many kinds have decreased and some have even been exterminated. But we know these so little that it is not possible to point out many instances. However, the following species are known to have decreased:

The blue-eyed grayling, *Cercyonis alope,* appears to be diminishing. Scudder ('86) included the entire State in its range. Blatchley ('91) said that it was not found south of Wabash County. Ellis says that it is now more scarce than ever, being restricted to the three northern tiers of counties. The food plants are wild grasses and sedges. The butterfly frequents swampy woodlands and is being exterminated by the draining and pasturing of these.

Hornets, yellow jackets and many wasps are less numerous than formerly. They are destroyed by man at every opportunity because of the painful wounds which they inflict. Since they live in colonies, the destruction of a large number is an easy matter. Cultivation of the soil also destroys yellow jackets and other burrowing species.

The rhinoceros beetle, *Dynastes tityrus,* was once a common inhabitant of the forest. The larvae live in decaying wood and clearing the forest has removed much of their food supply. The large size and unusual appearance of the beetle has aided in its destruction by making it an object of curiosity and fear and consequently leading people to kill it. Its slow and clumsy movements have also hastened its destruction.

The walking stick, *Diaphemora femorata,* and the rear-



Sketch map of a part of Harrison County showing the slow dispersal of the imported elm leaf beetle, *Galerucella luteola*. Scale, about eight miles to the inch. In 1906 the beetle was found around Corydon, and from 1905 to 1906 around Elizabeth and New Middleton. [Data omited from the map by oversight.] Redrawn from the original of M. M. Ellis.

horse or praying mantis, *Stagomantis carolina,* were also common at one time. They are both of such extraordinary appearance as to attract attention and consequently both have been killed wantonly because people "do not like bugs." The former is known as the devil's darning needle and doubtless the word "devil" in association with it has created something of a superstitious fear for it. There has also been a reduction of mosquitoes and other aquatic insects, due to draining of marshy land.

To summarize the changes of insect fauna: The increase has been more marked than the decrease. A number of species have been introduced by man and some have migrated into the State. It is difficult to destroy the species that are pests because they are not easy to find, and many have a very rapid rate of reproduction. The introduced species have a good chance in the struggle for existence because they have few enemies and an abundant food supply.

The species native to the United States but new to Indiana have apparently migrated in from the south and west. The eastern migration is easily explained, as the prairie species from regions immediately west have only been able to find congenial homes and food after the forests were cleared. The northward migration is not so easily explained. May it be a part of the general northward movement of the temperate biota that followed the retreat of the ice sheet?

The insects that have diminished are aquatic or wood loving species whose homes or food have been destroyed, or they are species harmful to man, or they are of such unusual size or appearance as to attract notice.

GENERAL SUMMARY.

There is a tendency for certain ecological groups to disappear and for others to increase. Those that tend to disappear are:

1. Large species; not only have the larger species of the fauna, as bison and wapiti, disappeared, but the largest species of any natural group tend to disappear before the smaller species of the same group.
2. Aquatic species suffer from changes in the various bodies of water.
3. Forest-dwelling species are exterminated through loss of homes and food.
4. Species dangerous or supposedly dangerous to man are killed off.
5. Species economically injurious are actively destroyed *whenever possible.*

6. Species valued for sport or for any animal product are killed and tend to disappear; not one species native of Indiana has been domesticated.

7. Species that breed slowly tend to disappear. (These are usually large species with few enemies.)

8. Species with gregarious habits are more easily killed than those with solitary habits, hence tend to disappear.

The groups that tend to remain stationary or to increase are the following:

1. Small species.
2. Species that have a high birth rate.
3. Species that have: (a) great cunning, or (b) great timidity.
4. Prairie Species: there is unquestionable evidence of an eastward movement of the fauna, due to deforestation, and some indication of an unexplained northward movement.

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Our Birds in August and September.

BROTHER ALPHONSUS, C. S. C.

The autumn migration of certain species among the birds presents some inexplicable facts to the writer. He is unable to ascertain why the Cowbird, Red-winged Blackbird and Purple Grackle should leave even before the end of summer. They, being among the early spring arrivals, should naturally depart later, when most of the first spring migrants do. Another curious thing is the total absence of the Spotted Sandpiper from his summer haunts along the shores of lakes before he really migrates south. I have found this species near rivers long after leaving the lakes.

Certain species are absent from this locality for a considerable period and then reappear—some seldom and others often. Among the former are the Redstart, Phoebe, Nighthawk and Chickadee; among the latter is the Towhee. The writer is equally unable to account for the strange movements of these species.

As the season of migration advances, the various species that were abundant during summer begin to appear irregularly. This fact leads the writer to surmise that most of the species migrate gradually and in small numbers, leaving gaps in their distribution. Even those that migrate in large flocks do not disappear altogether. Individuals may be seen here and there for several days after the main body has departed.

Birds seen every day:

Song Sparrow
Blue Jay
Chipping Sparrow

Birds not seen on any day:

Crested Flycatcher
Dickcissel
Rose-breasted Grosbeak
Phoebe
Bobolink
Scarlet Tanager
Yellow Warbler
Whip-poor-will
Nighthawk
Bobwhite